The opinion in support of the decision being entered today was not written for publication in a law journal and is not binding precedent of the Board.

Paper No. 29

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte SHIGERU KUSUNOKI and
HIDEKAZU ODA

_____

Appeal No. 1998-0088
Application 08/633,327[1]

_____

ON BRIEF

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Before THOMAS, MARTIN, and FLEMING, Administrative Patent Judges.

MARTIN, Administrative Patent Judge.

DECISION ON APPEAL

[1] Application for patent filed March 26, 1996.

This appeal was taken from the October 24, 1996, Office action[2] finally rejecting claims 1, 3, 4, 7, 8, 10, 11, and 15-16. We reverse and remand.

. Reasons for the remand

In the final Office action, the foregoing claims were rejected on the following grounds:[3]

(a) claim 8 under 35 U.S.C. § 112, first paragraph;

(b) claims 10 and 11 under § 112, second paragraph;

(c) claims 15 and 16 under § 102(b) for anticipation by, and alternatively under § 103 for obviousness over, Fujii et al. (Fujii);

(d) claims 1 and 3 under § 103 for obviousness over Kusunoki et al. (Kusunoki);

(e) claims 1, 3, and 4 under § 103 for obviousness over Kusunoki in view of Shinada et al. (Shinada);

(f) claims 7, 8, 10, 11, 15, and 16 under § 103 for obviousness over Yamauchi et al. (Yamauchi) in view of Fujii; and

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[2] Paper No. 17.

[3] Claims 2 and 17-20 were indicated as allowed, claims 5 and 6 were indicated as objected to for depending from rejected claims, and claim 9 was indicated as canceled.

(g) claims 7, 8, 10, 11, 15, and 16 for obviousness-type double patenting in view of claims 1 and 2 of Patent 5,369,297.

On January 2, 1997, appellants filed an amendment after final[4] pursuant to 37 CFR § 1.116 and on January 9, 1997, filed a terminal disclaimer[5] to obviate the double patenting rejection.

In an Advisory Action mailed January 27, 1997, the examiner indicated that the amendment after final would be entered upon the filing of an appeal and would be effective to overcome the rejection of claims 10 and 11 on reference grounds and the rejections of claims 8, 10, and 11 on non-reference grounds.

In the Answer (at 1) the examiner, citing the persuasiveness of appellants' arguments at pages 12-17 of the Brief concerning the § 103 rejection of claims 1 and 3 based on Kusunoki and the § 103 rejection of claims 1, 3, and 4 based on Kusunoki in view of Shinada, the examiner withdrew the rejections of claims 1, 3, and 4. Also, citing the persuasiveness of some of the arguments at pages 17-19 of the Brief, wherein appellants discussed the § 103 rejection of claims 7, 8, 15, and 16 based on Yamauchi in view of Fujii, the examiner

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[4] Paper No. 20.

[5] Paper No. 19.

withdrew that ground of rejection only with respect to claims 7 and 8 (Answer at 1). As a result, the failure of the Answer to repeat that ground of rejection with respect to claims 15 and 16 or to address appellants' arguments directed thereto appears to have been an oversight on the examiner's part, which the examiner is invited to correct on remand in a Second Supplemental Examiner's Answer. Accordingly, this application is remanded to the examiner to correct this apparent oversight.

B. The invention

Appellants' application discloses a number of embodiments of nonvolatile semiconductor memory devices employing transistors having nitrided oxide films. The Figure 1 embodiment includes two types of such films. Film 22, referred to as a nitrided oxide (NO) film, contains nitrogen at a content not less than $2.5x10^{20}/cm^3$ and hydrogen at a content of $3x10^{20}/cm^3$ or more (Spec. at 18, ll. 10-13). Film 22 overlies the channel hot electron (hole) carrier injection region 20 in order to increase the injection efficiency of the channel hot electrons (Spec. at 18, ll. 15-17 and at 19, ll. 13-16). This improves the writing efficiency without increasing the drain and gate

voltages, thereby permitting the writing operation to be performed at a high speed even with a low voltage supply (Spec. at 19, ll. 16-20).

Film 12, referred to as a re-oxidized nitrided oxide (RNO) film, contains nitrogen at a content not less than $2.5x10^{20}/cm^3$ and hydrogen at a content less than $3x10^{20}/cm^3$ (Spec. at 18, ll. 2 and 8-10). Film 12 overlies the drain avalanche hot carrier injection region 10 in order to suppress the injection of drain avalanche hot carriers (Spec. at 18, ll. 17-19 and at 19, ll. 21-25). As a result, even if the electric field near the drain region 7 increases due to miniaturization, generation of an interface level due to implantation of drain avalanche hot carriers can be effectively prevented (Spec. at 19, l. 25 to p. 20, l. 5).

In addition to the embodiment depicted in Appellants' Figure 1, the drawings show ten other embodiments (Spec. at 15-16).

C. The claims

Claim 15, the sole independent claim on appeal, reads as follows:

15. A semiconductor memory device comprising:

a semiconductor substrate; and

> a single transistor comprising:
>
> a source region and a drain region formed on said main surface of said semiconductor substrate with a predetermined space between each other and are located at opposite sides of a channel region;
>
> a nitrided oxide film formed at least at a drain avalanche hot carrier injection region on said main surface of said semiconductor substrate, and containing nitrogen at a content not less than $2.5x10^{20}/cm^3$ and hydrogen at a content less than $3x10^{20}/cm^3$;
>
> a gate electrode formed on said channel region; and
>
> a silicon oxide film formed on said channel region continuous to said nitrided oxide film.

In view of the way the term "continuous to" is used in the specification (see page 18, lines 5-7, page 25, lines 15-17, page 35, lines 22-24, page 40, lines 8-10, page 41, lines 4-5, and page 41, lines 3-4), that term is understood to mean "in direct contact with."

Claim 15 recites a silicon oxide formed on the channel region continuous to a nitrided oxide film having a nitrogen content not less than $2.5x10^{20}/cm^3$ and a hydrogen content less than $3x10^{20}/cm^{3)}$, which as noted above is referred to in the specification as an RNO

film (12 in Figure 1).[6] Consequently, claim 15 reads on the "eighth" embodiment shown in Figure 44, which includes a silicon oxide film 2d that is located between and in direct contact with RNO films 12d.

D. The reference and rejections

The only rejections argued in the answer are based on the following reference:

Fujii et al. (Fujii) 5,063,423 Nov. 5, 1991

Claims 15 and 16 stand rejected under § 102 as anticipated by Fujii and, alternatively, under § 103 for obviousness over Fujii.

E. The merits of the rejections

The examiner contends that claims 15 and 16 are anticipated by the semiconductor device shown in Fujii's Figures 1A-1G. Specifically, in the Final Office action[7] the examiner reads the claimed nitrided oxide film on tunneling layer 14, which the examiner describes as located over drain region 13 and continuous with the silicon dioxide layer 17. The examiner further contends that the claimed nitrogen content is shown in Figures 12A-12C and that the

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[6] Claim 15 does not also require a nitrided oxide of the NO type.

[7] Paper No. 17.

claimed hydrogen content "is considered to be inherent in the RNO tunneling layer 14 of Fujii et al. or obvious to one of ordinary skill in the art since Fujii et al. teach that eliminating nonreacted hydrogen and hydrogen compounds from the film is desirable to prevent film breakdown" (Final Office action at 4).

We are reversing the rejection because we agree with appellants that the examiner has not cited any evidence which prima facie establishes that Fujii's tunneling layer 14, which is located entirely over and near the center of drain region 13, is located "at least at a drain avalanche hot carrier injection region on said main surface of said semiconductor substrate," as required by claim 15. In fact, the location requirement in this limitation is not even addressed by the examiner, who argues with respect to this limitation only that Fujii's device inherently includes a drain avalanche hot carrier injection region (Answer at 5). The examiner's failure to explain why the claimed location requirement is inherently satisfied fails to satisfy the PTO's initial burden of proof when arguing inherency. Cf. In re King, 801 F.2d 1324, 1326, 231 136, 138 (Fed. Cir. 1986) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing

novelty in claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic relied on). While not argued by the examiner, we note that even if Fujii's description of layer 14 as a "tunneling" layer and reference to "electron injection" at column 1, line 49 can be understood to mean that electrons are injected from drain 13 through tunneling layer 14 to floating gate 181 (Fig. 1G; col. 4, ll. 45-46), it does not follow that the injected electrons inherently are "avalanche" carriers, as required by claim 15. In fact, such a conclusion is contrary to appellants' disclosure. In Appellants' Figure 1 embodiment, the drain avalanche hot carrier injection region 10 is located within the channel region 35 and adjacent to the junction of the channel region and drain 7. Thus, a drain avalanche hot carrier injection region developing in the corresponding location in Fujii's device would not

lie under Fujii's tunneling layer 14, as in necessary for Fujii to inherently satisfy claim 15.[8]

For the foregoing reasons, we are reversing the § 102(b) rejection of claims 15 and 16 for anticipation by Fujii.

We are reversing the § 103 rejection of claims 15 and 16 based on Fujii because the examiner has not explained how or why it would have been obvious to modify Fujii's device in order to satisfy the requirement that the nitrided oxide layer be at least at the drain avalanche hot carrier injection region.

This decision contains a new ground of rejection pursuant to 37 CFR § 1.196(b) (amended effective Dec. 1, 1997, by final rule notice, 62 Fed. Reg. 53,131, 53,197 (Oct. 10, 1997), 1203 Off. Gaz. Pat. & Trademark Office 63, 122 (Oct. 21, 1997)). 37 CFR

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[8] Min-Liang Chen et al., "Suppression of Hot-Carrier Effects in Submicrometer CMOS Technology," 35 IEEE Transactions on Electron Devices 2210-20 (December 1998), of which a copy was provided with the Brief, shows (at 2211, Fig. 1) that the drain avalanche hot carrier injection region is located within the channel region and adjacent to the lightly doped (N^-) drain region when the drain includes a lightly doped (N^-)region and a heavily doped (N^+) region, which is not the case in Fujii's device. The positional relationship shown in Chen et al. also appears in appellants' Figure 20 (Spec. at 29, l. 21 to p. 30, l. 3).

§ 1.196(b) provides, "[a] new ground of rejection shall not be considered final for purposes of judicial review."

37 CFR § 1.196(b) also provides that the appellants, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of proceedings (37 CFR § 1.197(c) as to the rejected claims:

> (1) Submit an appropriate amendment of the claims so rejected or a showing of facts relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the application will be remanded to the examiner . . . .
>
> (2) Request that the application be reheard under § 1.197(b) by the Board of Patent Appeals and Interferences upon the same record . . . .

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

REVERSED; 37 CFR § 1.196(b)

JAMES D. THOMAS Administrative Patent Judge	)	
JOHN C. MARTIN Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
MICHAEL R. FLEMING Administrative Patent Judge	)	

JCM/sld

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